JAPANESE [JP,11-205849,A]

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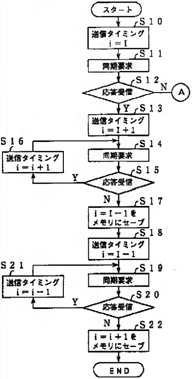
DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]WLL this invention has two or more base stations, and using time division multiplexing (TDMA: Time Devison Multipul Access) (Wireless Local Loop), Or in systems, such as PHS (Personal Handy Phone System), it is related with interference between the base stations by the propagation delay of the electric wave which originates in the distance between base stations and is generated.
[0002]
[Description of the Prior Art]Two or more base stations are provided, and in mobile communications systems, such as PHS in which each base station transmits and receives by TDMA between mobile stations, if the frame

Drawing selection
Representative drawi



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synchronization of the transmission and reception signals of each base station does not have ** and ******, two or more continuous time slots will receive interference with the transmission and reception signals from an adjoining base station. It becomes impossible to use the radio channel of that timing, and it will become impossible for this reason, to aim at effective use of an electric wave. For this reason, in order to take the synchronization of the frame signal transmitted in each base station, a master base station is selected from two or more base stations, and he is trying to double the timing of slave base stations with the timing of the frame of a master base station by making the remaining base stations into slave base stations.

[0003]Drawing 8 is a figure showing a relation contemporary with the above-mentioned master base station and slave base stations. In the case of this example, the frame comprises transmission section 4 slot (T1-T4) and receive section 4 slot (R1-R4), and the guard bit is provided between each slot. In drawing 8, 1 is a master base station and 2 is slave base stations. Drawing 8 (a) shows the transmission frame which the master base station 1 transmits, and the reception frame which the slave base stations 2 receive, and the slave base stations 2 receive drawing 8 (b) by the slot R1, It is the example for which send data was embedded into the slot T1, it transmitted to it, and the master base station 1 received this by the slot R1. In this case, since the distance between base stations is short, delay of a signal falls within the range of a guard bit, and the interference between contiguity slots does not take place in the master base station 1.

[0004]When the distance between base stations is large, the propagation delay of a signal stops however, falling within the range of a guard bit. Drawing 8 (c) and (d) is what showed this example, and drawing 8 (c) is the example which the slave base stations 2 embedded data into the slot T1, and transmitted to it to the data received by the slot R1 of drawing 8 (a), and the master base station 1 received by the slot R1. As shown in a figure, the data of the slot R1 was not settled between guard bits, but it was postponed even until the following slot, and interference of timing has occurred in the master base station 1. Drawing 8 (d) expands this relation.

[0005]In order to solve this problem, in JP,9-148978,A, it is

going to solve in a master base station by the method of adjusting the delaying amount of the travelling period over each slave base stations, based on the signal which the slave base stations which received the sending signal from a master base station reply.

[0006]

[Problem(s) to be Solved by the Invention]However, in the method currently indicated by above-mentioned JP,9-148978,A, the master base station had to adjust to all the slave base stations, and when the number of slave base stations increased, there was a problem that the processing in a master base station will be complicated.

[0007]It is what was made in order that this invention might solve the above problems, By adding the easy processing for slave base stations for interference between the base stations which originate in the distance between base stations and are generated and to carry out, the suitable transmit timing in slave base stations is obtained, and it aims at providing the method of establishing the synchronization between base stations.

[0008]

[Means for Solving the Problem]As a base station synchronization timing establishment method concerning this invention has the following element, it obtains suitable transmit timing.

(a) A step which transmits a synchronous request signal to predetermined timing, a step which detects a reply signal over the (b) above-mentioned synchronous request signal, (c) A step which changes transmit timing of the above-mentioned synchronous request signal one by one, a step which searches for the range of transmit timing from which a response to the (d) above-mentioned synchronous request signal is obtained, a step which asks for transmit timing suitable based on the range of transmit timing for which it (e) Asked.

[0009]It brings forward one clock of the above-mentioned predetermined timing at a time, or it delays and the range of the above-mentioned transmit timing is searched for.

[0010]Be made to let suitable transmit timing be a midrange value of transmit timing for which it asked.

[0011]As it has the following element, suitable transmit timing is obtained.

(a) In a step, and the (b) 2nd base station which transmit a

synchronous request signal to predetermined timing in the 1st base station, In a step and the 2nd base station of (c) above which receive the above-mentioned synchronous request signal, A step which detects a difference of receiving timing which received the above-mentioned synchronous request signal, and the optimal receiving timing of self, (d) In a step and the 1st base station of (e) above which transmit a difference of detected timing as a part of information on a reply signal of the above-mentioned synchronous request signal, A step which detects a reply signal over the above-mentioned synchronous request signal, a step which asks for transmit timing suitable based on the above-mentioned information in the (f) above-mentioned reply signal.

[0012]As it has the following element, suitable transmit timing is obtained.

(b) [a step which asks for distance data between each base station, and] (a) A step which registers into a predetermined device distance data between each base station for which it asked, (c) A step which transmits the above-mentioned distance data to each base station from the above-mentioned predetermined device, a step which computes data delay time between base stations based on the (d) above-mentioned distance data, a step which computes transmit timing suitable based on a time delay which carried out (e) calculation.

[0013]As it has the following element, suitable transmit timing is obtained.

(b) [a step which asks for distance data between each base station, and] (a) A step which registers into a predetermined device distance data between each base station for which it asked, (c) In a step which transmits the above-mentioned distance data to the 1st base station from the above-mentioned predetermined device, a step which transmits the above-mentioned distance data to the 2nd base station from the (d) 1st base station, and the (e) 2nd base station, A step which computes transmit timing suitable based on a computed time delay in a step, and the (e) 2nd base station which compute data delay time between the 1st base station and the 2nd base station based on the above-mentioned distance data.

[0014]The above is equipped with either of the base station synchronization timing establishment methods of a

statement in a TDMA system.
[0015]
[Embodiment of the Invention]Embodiment 1. drawing 1 is a figure showing the composition of a portion required for the frame synchronization between the master base station and slave base stations concerning this embodiment of the invention 1. In a figure, 1 is a master base station, The high frequency switch 11 switched to either of the receive sections 13 which receive the transmission section 12 which transmits the transmitting antennas 10 and the transmitting antennas 10 for a frame signal etc., or a frame signal, CPU14 which perform processing of the whole master base station (a memory is included), It has the timing circuit 16 which outputs the synchronizer 15 and frame signal which synchronize the received frame signal in the timing of a local station.
[0016]2 is slave base stations, the high frequency switch 21 switched to either of the receive sections 23 which receive the transmission section 22 which transmits the transmitting antennas 20 and the transmitting antennas 20 for a frame signal etc., or a frame signal, and CPU24 which perform processing of the whole master base station -- and. [receive and] It has the synchronizer 26 which synchronizes the frame signal of a local station with the acquired frame signal.
[0017]Drawing 2 is a figure showing the concept of Embodiment 1 in this invention. In drawing 2 (a), 1 is a master base station and 2, 3, and 4 are slave base stations. Each slave base stations 2, 3, and 4 transmit the synchronous request between base stations to the master base station 1 using a control channel. By changing various timing of this sending signal, as shown in drawing 2 (b), the range of the timing which can receive the master base station 1 is searched for.
[0018]Drawing 3 and drawing 4 are the flow chart figures in this Embodiment 1 showing detailed operation of the slave base stations 2-4. The operation in this Embodiment 1 is explained below, referring to a figure.
[0019]The master base station 1 transmits the frame signal generated in the timing circuit 16 via the transmission section 12 and the high frequency switch 11 by a predetermined slot. The slave base stations 2 receive the frame signal from the master base station caught with the

transmitting antennas 20 via the high frequency switch 21. The frame signal reproduced in the receiving circuit 23 is synchronized with the transmit timing of a local station in the synchronous circuit 25. Timing i at this time (timing of initial setting) is set to I (Step S10).

[0020]The slave base stations 2 are this transmit timing, and transmit the synchronous request between base stations to the master base station 1 via the transmission section 22 and the high frequency switch 21 (Step S11). The slave base stations 2 wait for the response from the master base station 1. The master base station 1 will return a reply signal, if the synchronous request signal from the slave base stations 2 can be synchronized. The slave base stations 2 will transmit 1 clock ****** (Step S13) and a synchronous request for transmit timing, if this response is received (Step S14). Henceforth, the slave base stations 2 repeat the operation which advances at a time one clock of night message timing which the master base station 1 can answer, and transmits a synchronous request (Step S16 - Step S15), detect the transmitting clock timing most brought forward, and store this in the memory (Step S17).

[0021]Next, the slave base stations 2 delay one clock transmit timing I of initial setting at a time, transmit a synchronous request, detect the transmit timing with which the master base station 1 can synchronize (Step S17 - Step S21), and store the timing in the memory (Step S22).

[0022]The earliest transmit timing to the transmit timing (i=I) of initial setting for which it asked as mentioned above with +2 clock. Supposing the latest transmit timing is -4 clock, the optimal transmit timing is 1 clock ******** timing to the transmit timing of /(+2-4)2=-1, i.e., initial setting, to the transmit timing (i=I) of initial setting. Drawing 5 illustrates this.

[0023]The transmit timing (i=I) of drawing 4 of initial setting is unsuitable, and it is a flow chart figure showing processing when the master base station 1 is not able to answer the synchronous request from the slave base stations 2 from the beginning (when response reception is N at Step S12 of drawing 3). Hereafter, it explains, referring to this flow chart figure.

[0024]1 clock early ** (Step S30) and a synchronous request are transmitted for transmit timing (Step S31), If there are not waiting (Step S32) and a response about the

response from the master base station 1, it brings forward one clock of transmit timing at a time (Step S34), If the clock number brought forward judges whether it became a predetermined value (Step S33) and serves as a predetermined value, even if it brings a clock forward more, it will judge that it is useless, and a synchronous request will be transmitted for a transmit clock from the timing (i=I) of initial setting to 1 clock ******** timing (Step S35).

[0025]On the other hand, when the response from the master base station 1 is able to be received while bringing forward one clock of transmit timing at a time and going, the value at that time is stored in the memory (Step S50), and it is considered that this is the most overdue transmit timing. Furthermore transmit timing is brought forward, the earliest transmit timing is detected (Step S51 - Step S53), and this value is stored in a memory (Step S54). The optimal transmit timing can be obtained by the above processing.

[0026]Even if it advances transmit timing, when the response from a master base station is not obtained, 1 clock ******** (Step S35) and a synchronous request are transmitted for transmit timing from initial setting as mentioned above (Step S36), If there are not waiting (Step S37) and a response about the response from the master base station 1, it delays one more clock of transmit timing at a time (Step S39), Even if it delays to predetermined timing, when there is no response, alarm is taken out as (Step S38) and a synchronization being impossible (Step S40) (Step S41).

[0027]On the other hand, when a response is obtained to a certain timing, the value at that time is stored in the memory (Step S60), and it is considered that this is the earliest transmit timing. Furthermore transmit timing is delayed, the latest transmit timing is detected (Step S61 - Step S63), and this value is stored in a memory (Step S64). The optimal transmit timing can be obtained by the above processing.

[0028]Although it changes one clock of transmit timing at a time and the synchronous request was transmitted, multiple-clocks change is carried out and it may be made to change one clock at a time near the limit in the above-mentioned example not only at this method but at the beginning. It may be made to perform the initialized direction which brings transmit timing forward, and the direction to delay by turns. When the range of transmit timing is wide, it is not

necessary to necessarily set transmit timing as the median of the transmit timing delayed most and the transmit timing most brought forward.

[0029]As mentioned above, according to this above-mentioned Embodiment 1, suitable transmit timing can be obtained by processing of only slave base stations.

[0030]Embodiment 2. drawing 6 is a flow chart figure explaining operation with the master base station and slave base stations in this Embodiment 2. Hereafter, operation is explained using drawing 1 and 6. The master base station 1 transmits the frame signal generated in the timing circuit 16 via the transmission section 12 and the high frequency switch 11 by a predetermined slot. The slave base stations 2 receive the frame signal from the master base station caught with the transmitting antennas 20 via the high frequency switch 21. The frame signal reproduced in the receiving circuit 23 is synchronized with the transmit timing of a local station in the synchronous circuit 25. Timing i at this time (timing of initial setting) is set to I (Step S70). The master base station 1 calculates the optimum value of own receiving timing by CPU14 based on the frame counter, and stores the value in the memory (Step S80).

[0031]The slave base stations 2 are this transmit timing, and transmit the synchronous request between base stations to the master base station 1 via the transmission section 22 and the high frequency switch 21 (Step S71). The slave base stations 2 wait for the response from the master base station 1. The master base station 1 will search for a difference with the optimal receiving timing which stored this receiving timing in the memory with a clock number, if the synchronous request signal from the slave base stations 2 is received (Step S81) (Step S82). This value is set to T. Step S83 which embeds as information the difference T of the receiving timing for which it asked into the reply signal to the slave base stations 2, and transmits a reply signal. If this reply signal is received, the slave base stations 2 will take out the receiving timing difference data T in the master base station 1 currently embedded in the reply signal (Step S72), and will set transmit timing as (I+T) based on this data (Step S73).

[0032]As mentioned above, according to this Embodiment 2, the optimal transmit timing can be set up by easy processing.

[0033]Embodiment 3. drawing 7 is a figure showing other embodiments of this invention. In a figure, it is a control device with which 1 controls a master base station, 2, 3, and 4 control slave base stations, and 5 controls the master base station 1. In this Embodiment 2, since the installed position of each base station is known, it calculates the propagation delay time of a signal using the distance between each base station being computable beforehand, and obtains the optimal transmit timing.
[0034]Distance of the master base station 1 and the slave base stations 2, 3, and 4 is set to d1, d2, and d3, respectively. Distance between the slave base stations 2 and the slave base stations 3, distance between the slave base stations 2 and the slave base stations 4, and distance between the slave base stations 4 and the slave base stations 2 are set to d12, d13, and d23, respectively.
[0035]The distance data between each above base station is registered into the control device 5, and this data is transmitted to each base station at the time of initial setting. namely, the control device 5 -- the master base station 1 -- d1, d2, and d3 -- d2, d12, and d23 are transmitted to the slave base stations 3, and d3, d23, and d31 are transmitted for d1, d12, and d31 to the slave base stations 4 in the slave base stations 2. In each slave base stations 2, 3, and 4, the propagation delay time of a signal is calculated and found by CPU. That is, it asks by carrying out division process of the distance with the received master base station 1 with the propagation rate of an electric wave. And it asks for suitable transmit timing from the found time delay.
[0036]In this Embodiment 3, suitable transmit timing is easily computable only in slave base stations as mentioned above. Since the distance data between related base stations was transmitted to all the base stations, when a master base station is downed, it can process replacing a master base station and slave base stations etc. easily. The radio procedure between the master base station and slave base stations in initial setting can be simplified.
[0037]embodiment 4. -- this Embodiment 4 transforms Embodiment 3. In Embodiment 4, although he was trying to transmit the distance data of the base station and other base stations from a control device to each base station, the distance between each base station, The control device 5 transmits all the data about the distance between base

stations to the master base station 1, and the master base station 1 distributes this data to each slave base stations 2-4, and transmits it. Even if it does in this way, an effect equivalent to Embodiment 3 can be acquired.

[0038]

[Effect of the Invention]As mentioned above, according to this invention, since various transmit timing is changed and the range of the transmit timing which can receive in a master base station was detected, suitable transmit timing can be set up.

[0039]Since it changes one clock of transmit timing at a time and detected whether it was ability ready for receiving in the master base station, a detection program can be created in easy logic.

[0040]Since the midrange value of the detected transmit timing was set up as transmit timing, the optimal transmit timing can be obtained.

[0041]Since the master base station told slave base stations about the difference of the timing of the optimum value of own receiving timing, and the receiving timing which received, the suitable transmit timing in slave base stations can be set up easily.

[0042]Since a control device manages the distance data between each base station collectively and this data was transmitted to each base station, the propagation delay time of a signal can be calculated easily and suitable transmit timing can be set up. It becomes easy to set a master base station as other base stations.

[Translation done.]